THE RIVERS AT JOHNSTOWN PENNSYLVANIA.

REPORT

TO THE BOARD OF TRADE OF THI

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BY

J. JAMES R. CROES,
M. Am. Soc. C. E., M. Inst. C. E.

JUNE 15, 1891.

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Printed by
THE ENGINEERING PRESS, 277 Pearl Street, New York City.

Illustrations by
W. H. MOMBERGER, 71 Broadway, New York City,
From Photographs developed and printed by
THE EASTMAN COMPANY, Rochester, N. Y.

Maps engraved by
STEVENS & MORRIS, 20 College Place, New York City,
From Drawings by
C. W. HUNT and R. K. APPLETON.

+ Hunt, miss Alice.

REPORT.

No. 13 William Street,
New York City,
June 15th, 1891.

To Messrs.
A. J. Moxham, G. W. Wagoner, James Quinn,
Committee of the Board of Trade,
of the City of Johnstown, Pa.

Gentlemen :—I have the honor to report the result of examinations made under your instructions, and in accordance with the resolutions adopted by the Board of Trade on February 27th, 1891.

The object of the investigations directed by you was to learn the condition of the dams existing on the streams tributary to the Conemaugh River in Johnstown, and the danger, if any, that exists from the presence of such dams on the streams ; the nature and extent of the obstructions now existing in Stony Creek, the Little Conemaugh and the Conemaugh Rivers, within the city limits, and the proper width that should be given to the rivers to enable them to carry off the waters of the highest flood without injury to the city.

General Description of Location.

The City of Johnstown is situated on a T-shaped plain, nearly level, at an elevation of 1,160 to 1,180 feet above the sea level, surrounded by steep hills.

This plain is about 20,000 feet long from north to south, and about 10,000 feet from east to west, averaging 2,000 feet in width.

The outlines of this plain, the boundaries of the City of Johnstown, the course of the river channels through it, the elevations of the principal points, and the outlines of the areas inundated in great floods, are shown on the accompanying "Plate 1."

Into this plain, Stony Creek, which has a drainage area of about 428 square miles, enters from the south and follows a winding course, generally along the base of the hills on the west, for about 15,000 feet to the point where it unites with the Little Conemaugh River, with a drainage area of about 193 square miles, which, entering at the northeast corner of the plain, flows generally along the northern boundary.

Below the confluence of these two rivers the stream is called the Conemaugh River, and flows through a valley of about 1,500 feet wide for about 10,000 feet to the city line near the mouth of Mill Brook, receiving in its course the discharge from Hingston's Run, which has a drainage area of about 18 square miles, and one or two other small streams, making the total drainage area tributary to the river below the Johnstown limits, about 650 square miles.

The general location and boundaries of these water-sheds are shown on the accompanying "Plate 2," compiled from the Pennsylvania State geological maps.

The streams tributary to the Conemaugh River, throughout the whole drainage area, flow in narrow valleys with precipitous slopes, and the channels of the streams are also steep.

The Dams Above Johnstown.

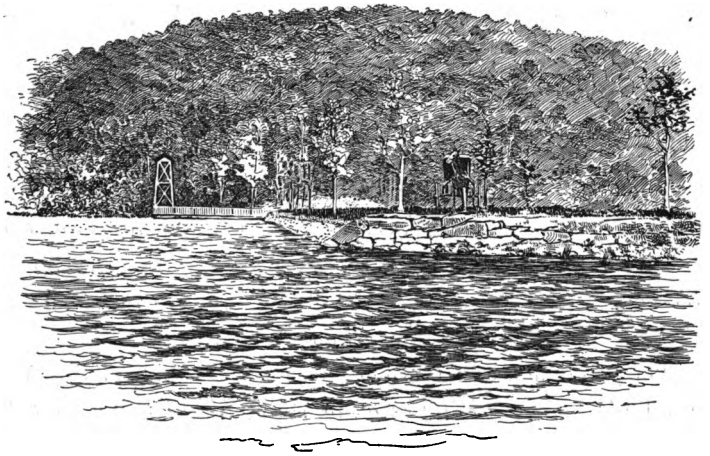
On the Little Conemaugh River, outside of the city limits, there is only one dam now standing, so far as can be ascertained. This is a dam belonging to the Johnstown Water Company, about four miles from Johnstown and 160 feet above the city level. It is a timber dam, built about eight years ago, 200 feet long and 6 feet high. The water flows over the crest of the dam for its whole length, falling on a timber apron. From a gate-house at the end of the dam a 20-inch pipe is led to the city.

The details of the construction of this dam could not be examined, as the water flows over it all the time. It appears to be solidly built, and from its dimensions and location there does not seem to be any danger of its breaking away, nor is it probable any damage would result to the city of Johnstown if it should break away.

The dam of the South Fork reservoir, the breaking away of which caused the disastrous flood of May 31, 1889, in Johnstown, has not been rebuilt.

In the Stony Creek water-shed the nearest dam to Johnstown is that of the Johnstown Water Company on Mill Creek, four miles from the city.

The dam is 310 feet long on top, which is 1,361 feet above sea level, or about 200 feet above the level of Johnstown, and is about 25 feet high above the lowest point of the valley.

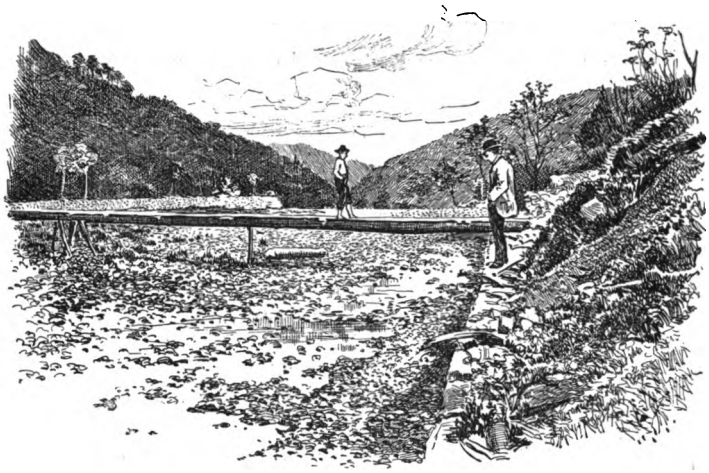


3. DAM OF MILL CREEK RESERVOIR OF THE JOHNSTOWN WATER COMPANY.

It was built in 1884, and the wasteway at that time was 44 feet wide. The dam is built of earth, 40 feet wide on top, with side slopes of 1½ to 1, and with a puddle wall 7½ feet wide in the centre from the hard clay bottom to the top of the dam.

On July 2, 1889, a freshet occurred which the wasteway was insufficient to carry off, and the water rose and flowed over the whole dam. After that the wasteway was widened so as to be 54.5 feet wide, and the dam was raised. The top of the dam is now 4 feet higher than the bed of the wasteway. The water is led from the reservoir through a 20-inch pipe laid through the bank.

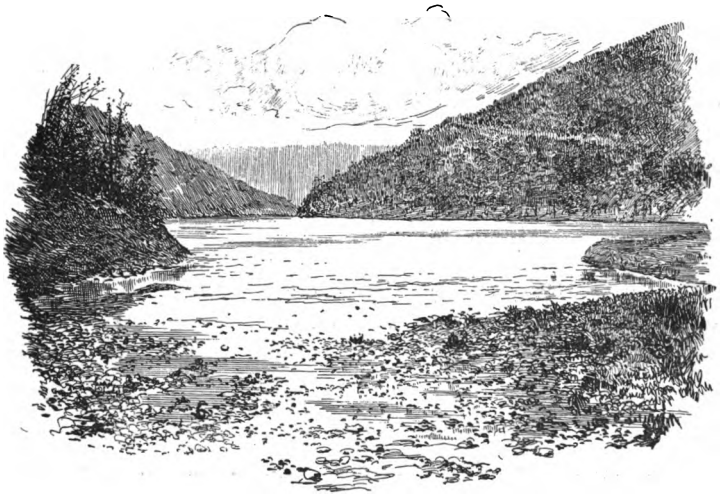
The area flooded is about 372,000 square feet, and the quantity of water impounded is about 4,300,000 cubic feet.



4. WASTEWAY OF MILL CREEK RESERVOIR.

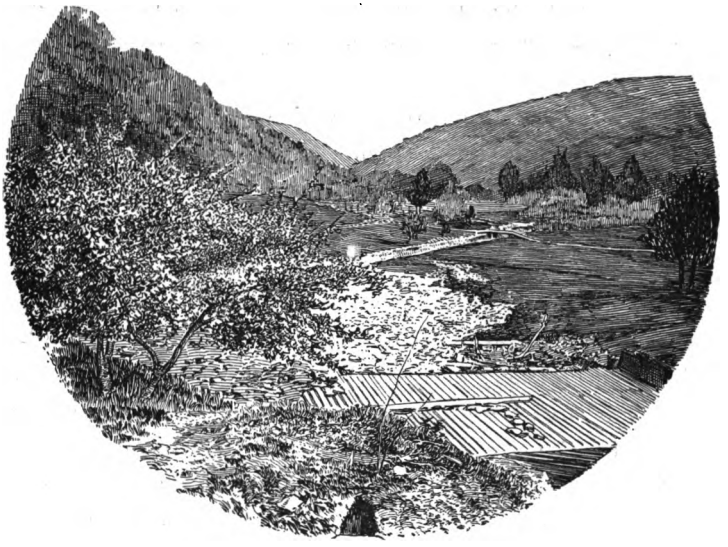
The dimensions of the dam and reservoir are shown on "Plate 6," made from my surveys. The general appearance of the dam and its relation to the water surface in the reservoir are shown on "Plate 3," the character of the wasteway on "Plate 4," and the extent of the reservoir formed on "Plate 5."

The points at which these views were taken and the direction of the line of sight, are indicated by arrow-heads on "Plate 6."



5 MILL CREEK RESERVOIR, FROM THE DAM.

So far as can be judged from examination of the dam and from the statements made regarding its construction, no danger is to be apprehended from its breaking away, or its being overflowed by freshets and endangered. Even should this dam be washed away by overflowing, which would discharge its contents gradually into the valley below, little danger is to be apprehended at Johnstown, inasmuch as the valley widens rapidly below the dam down to the junction of Mill Creek with Stony Creek, as is shown on "Plate 7," which is a view of the valley from the top of the dam looking down stream.



7. VALLEY OF MILL CREEK, BELOW DAM.

On Stony Creek below the mouth of Mill Creek there are also wide bottom lands. These would break the force of any wave or swell coming from the reservoir, and at any rate there is not enough water in the whole reservoir to flood to a depth of more than four inches the district in Johnstown which was inundated in June 1887, and February 1891.

The next dam in the Stony Creek water-shed is that of the Johnstown Lumber Company near the mouth of Shade Creek, twelve miles from Johnstown.

The bed of Stony Creek at the mouth of Shade Creek is about 1,464 feet above the sea level, or 300 feet above the level of Johnstown. The dam of the lumber company is on Shade Creek,

about 4,750 feet from its mouth, the bed of the stream at that point being 50 feet higher than Stony Creek.

The dam is 18 feet high in the centre and 332 feet long. It is built of timber cribs, and backed with stone and earth and sheathed with plank. For 165 feet from the south end the cribs composing the dam are not filled with stone. There are then stone-filled cribs, with a gate opening 8.5 feet wide with timber gate worked by hand. Next is a sluiceway 29.4 feet wide, closed by stop planks placed horizontally against timber posts. When it is desired to let out the water from the dam, these posts are cut away. The sill of this opening is about 10 feet below the top of the dam.

There is next a spillway, planked over, 82 feet long, with an apron of rough logs on which the overflow water falls. On the north bank stands the lumber company's sawmill. The location and dimensions of these structures are shown on "Plate 8," made from my surveys, and a very good idea of their construction can be obtained from "Plates 9, 10 and 11," which are from photographs taken on May 10, 1891, the points from which the views were taken being indicated on "Plate 8" by arrowheads. The area flooded by this dam is 434,000 square feet, and the quantity of water impounded is about 2,200,000 cubic feet.

The water-shed of the stream at this point is about 86 square miles. This pond is used by the Johnstown Lumber Company for the storing of logs brought down from the heavily timbered district on the upper waters of Shade Creek, which is now being cleared.

For checking the logs as they are brought down the stream by splashes, a boom of cribs has been built, extending up stream from the dam about 650 feet diagonally across the pond to a solid crib built out 120 feet from the south shore. The position of this boom is shown on "Plate 8," and its location and construction can be understood from inspection of "Plates 12, 13 and 14."

When the stream is in flood, and whenever the water is sufficiently high to admit of splashing, the pool above the crib is filled with logs. At the time of my visit to the dam, when the

water was low, the greater portion of the logs in the pool had been removed, but in the bed of the stream above the pond, great numbers of logs were lying which had been brought down by splashing, and which would be displaced and brought to the crib by the next splash or freshet.

The mass of timber thus ready to be brought down against the boom is very well shown by "Plate 15."

On Clear Shade Creek, about 16 miles above this dam, is the Splash dam of the lumber company. This dam is 346 feet long, and 13 feet high in the channel of the stream, and is built of timber cribs without filling above the surface of the ground, for 211 feet of its length. For 67 feet at one end of the dam, there are no cribs, but simply sheet piling, driven into the ground.

In the centre of the dam is an opening, in which are placed two timber gates, each 7 feet wide by 11 feet high. There is no spillway provided below the top of the dam, the only outlet for the impounded water being through these two gateways.

The dam backs up the water about a mile in the stream and impounds about 6,000,000 cubic feet of water.

The object of this dam is to furnish at a medium or low stage of water a means of flushing the river sufficiently to drive down to the boom dam the timber which has been cut from the adjoining hillsides and hauled and deposited in the bed of the stream.

In the month of April last there was sufficient water flowing in the stream to enable one and sometimes two splashes to be made every day. At a time when the streams were at about one-third flood, the water at Johnstown standing 5 feet on the gauge at Franklin street, and the snow melting on the mountains, the gates at this dam were opened at eight o'clock in the morning and the pond emptied in about four hours. The gates were closed again about three o'clock in the afternoon and the pond filled sufficiently for another splash by eight o'clock the next morning. It took about six hours for the flood of the splash to reach the boom dam.

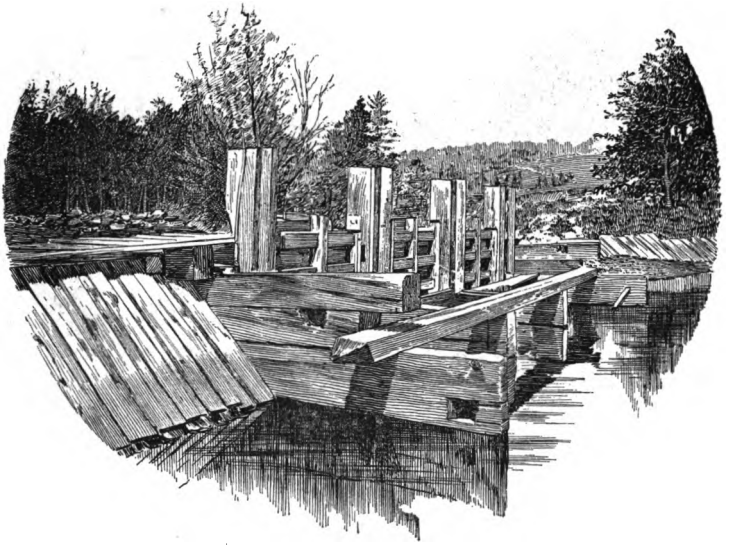
About 8 miles below this splash dam, Dark Shade Creek flows in from the south, the two streams forming Shade Creek.

16. SPILLWAY OF McGREGOR'S DAM.

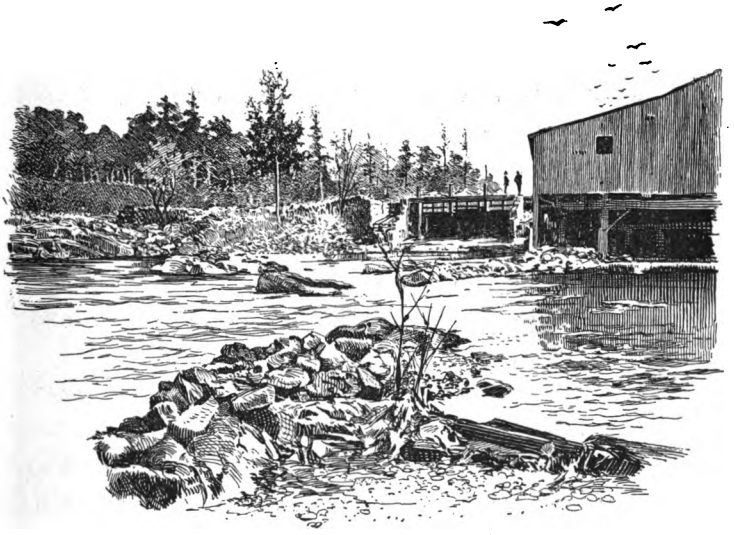
On Dark Shade Creek, 2.5 miles from the confluence, is McGregor's dam, which is 241 feet long and about 8 feet high in the centre. This dam backs the water up about a mile, impounding about 7,000,000 cubic feet. The dam is built of timber cribs filled with stone and has a spillway 59 feet long. This is sheathed with plank, as shown on "Plate 16."

The dam is provided with three gates, each 7 feet wide and 5.5 feet high, as shown on "Plate 17." This dam was originally built 32 years ago without gates or spillway. The water not drawn through the sluiceway to the saw mill ran over the top of the dam. Three years ago the spillway and gates were put in by the Lumber Company to enable the pond to be used for splashing, to assist in driving the logs in Shade Creek to the boom dam.

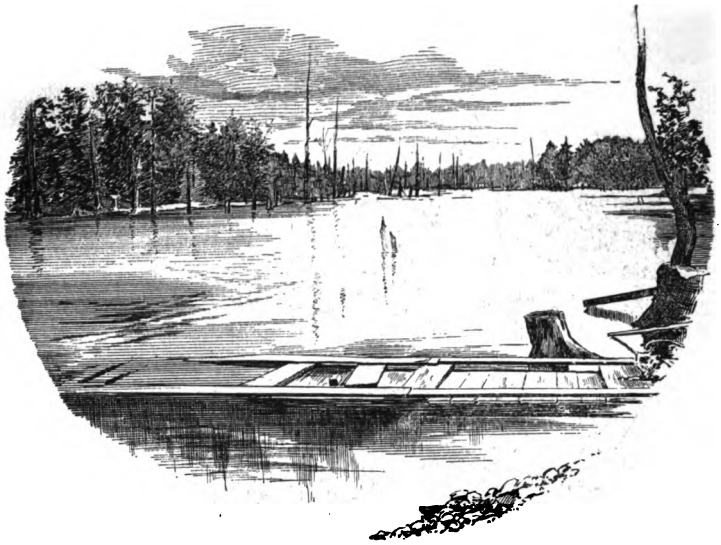
In the flood of February 17, 1891, with all the gates open, the water ran over the top of the dam. The appearance of the dam from below is shown on "Plate 18," and the pond itself on "Plate 19." No danger need be apprehended from this dam.



17. GATES AT McGREGOR'S DAM.



18. McGREGOR'S DAM, FROM BELOW.



19. POND ABOVE McGREGOR'S DAM.

Three-quarters of a mile below McGregor's dam, on Dark Shade Creek, there is a saw and grist mill at Reitz's dam, shown on "Plate 20." This dam is about 10 feet high and 100 feet long. The water runs over about half the length of the dam.

It is built of stone-filled cribs and has a rough log apron.

It backs the water up about ½ a mile and impounds about 1,500,000 cubic feet.

In splashes from McGregor's dam the water rises about 2.5 feet over the crest of the dam.

In the flood of February 1891, the water ran about 3.5 feet over the dam.

The owner considers that the dam is weakened by the frequent splashes from McGregor's dam, but I do not think that there is any danger to be apprehended to Johnstown from its being carried away.

The Splash dam on Clear Shade Creek, however, cannot be considered perfectly secure in its present condition. The danger to be apprehended from it is that it might be suddenly washed away in a freshet, and the volume of water contained in it coming down to the boom dam, bringing with it the logs on the stream, would drive the mass of logs above the boom dam over that dam

20. REITZ'S DAM ON DARK SHADE CREEK.

with the probable result of breaking it away, driving the whole mass down into Stony Creek, and consequently through Johnstown, as in any freshet sufficient to cause such a disaster there would be flowing in Stony Creek 20,000 to 30,000 cubic feet of water per second in a channel falling about 25 feet to the mile. There are several points within the city limits at which a jam of logs would unquestionably occur under such circumstances with results disastrous to the whole plain.

There is another splash dam belonging to the Johnstown Lumber Company on Quemahoning Creek, about 10 miles above the mouth of Shade Creek, but it is insignificant and no danger is to be apprehended from it so far as can be judged. It has not been used for two years, and the gates are open.

There are no other dams on the streams tributary to Stony Creek and the Little Conemaugh River.

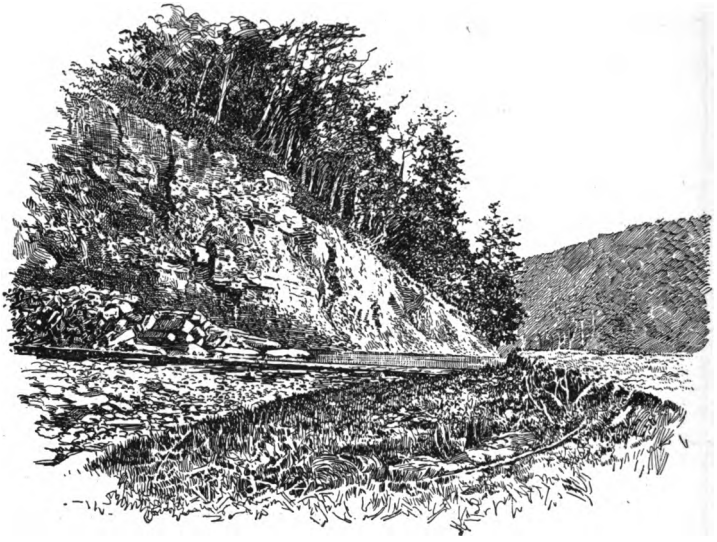
On Mill Run, which empties into the Conemaugh River near the northwesterly boundary of Johnstown, there is a dam belonging to the St. Clair reservoir of the Johnstown Water Company, the dimensions of which are shown on "Plate 21."

This reservoir contains about 2,000,000 cubic feet of water, and has a water-shed of 4.5 square miles tributary to it.

This dam is said to have been built about 1880, and to have been washed out once by a freshet and rebuilt. The water has never run over the top since it has been rebuilt. There has been a small leak through the dam ever since its construction, and the gate-keeper opens the gate whenever a hard rain occurs.

There are two puddle walls through the dam which have settled a number of times.

The dam is 460 feet long, and there is a wasteway 60 feet wide, which is now partially obstructed by rock fallen from the hillside, as shown on "Plate 22."



22. WASTEWAY OF ST. CLAIR RESERVOIR.

About a mile and a half above this dam, on the same stream, there is a small sawmill dam of very poor construction and liable to be washed out in any great freshet. If that should occur, the St. Clair dam would probably be washed out also, and probably great damage would be done where the stream passes through Morellville.

On Laurel Run, which empties into the Conemaugh River a little west of Johnstown, there is a reservoir of the Water company, about a mile and a half from the Conemaugh.

This dam is about 220 feet long and 18 feet high. The wasteway is 52 feet wide, paved with stone on edge and with side walls of dry stone. The area of water surface of the reservoir is about 100,000 square feet.

This dam is said to have been built about 1866, and to have been washed away in a flood a few years ago.

At present it appears to be in good condition, and its location is such that no danger to Johnstown could be caused even if it should give way.

The Rivers in Johnstown.

The Little Conemaugh.—The Little Conemaugh River enters Johnstown at the northeast angle of the city and flows in a generally direct course with curves of large radius, for 10,000 feet to the junction with Stony Creek, on an average descent of 4 feet in 1,000.

Its general width at the level of high water of February 1891, the highest flood recorded on this stream except the freshet of May 31, 1889, is 125 feet, with a depth of 12 feet.

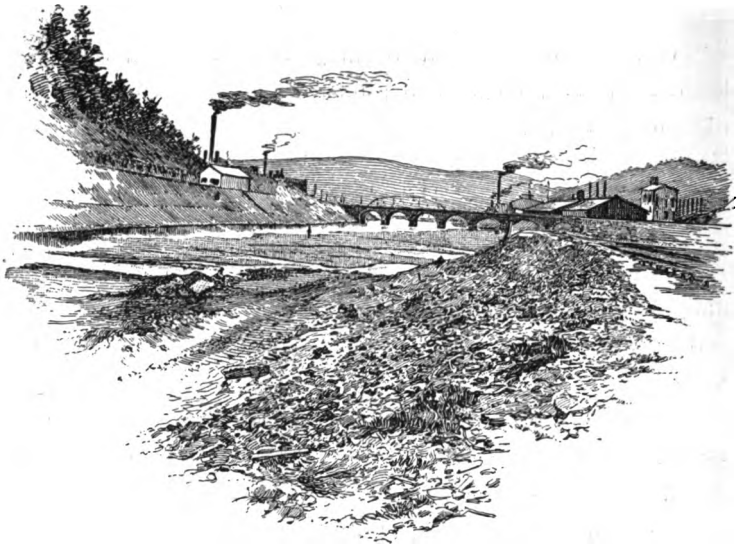
The volume of discharge in the flood of February 17, 1891, was 12,950 cubic feet per second, according to computations made by the engineer of the Cambria Iron Company from a measurement of the surface velocity made by him at the Cambria Iron Company's bridge, about 1,850 feet east of the mouth of the river.

On comparison of this with the sections and slopes of the flood water as obtained from my surveys, I think it is a close ap proximation to the correct volume of water flowing in the stream at that time. From the extent and character of the water-shed it is probable, however, that a discharge of 16,000 cubic feet per second may be expected in this stream at some time.

The banks in the upper part of the stream within the city limits are low, and overflowed during freshets.

At 7,500 feet from the mouth there is a dam across the stream 132 feet long and 7 feet high, which causes a material elevation of the water surface for some distance above it and flooding of the adjacent lands.

The banks of the stream have been raised by the dumping of cinder from the iron works in many places, and the extension of those embankments so as to make them continuous for some distance above and through the upper part of the city, will materially aid in preventing damage from overflow of the stream.



24. THE BAR AT THE MOUTH OF THE LITTLE CONEMAUGH.

The channel should nowhere be less than 125 feet wide at 12 feet above the bed of the stream, and the banks should be sloped back. At present, in consequence of the deposit of material on the south side of the railroad embankment near the mouth of the stream, the channel enters Stony Creek very nearly at right angles, causing a conflict of currents and the deposit of a heavy bar of gravel on the east side of Stony Creek, as may be seen on "Plate 24," which is a view of the bar taken from the east bank of Stony Creek just above the mouth of the Little Conemaugh.

On the extreme right of the picture is seen the temporary track from the iron works to the Plane bridge. In the middle foreground is the slope of the river bank where it has been raised by cinder filling. At the foot of the slope and extending nearly to the west bank is the heavy bar of gravel, intersected by numerous small channels through which the water of the Little Conemaugh meanders at this low stage of the stream, some of the rivulets running up stream in the bed of Stony Creek to the main channel near the west bank.

The east bank, as seen on the right of the picture, is about three feet higher than the highest floods of June 7, 1887 and February 17, 1891. The channel of Stony Creek is forced over to the west bank, and the flow of both streams obstructed.

Stony Creek.—Stony Creek enters Johnstown at the southwest angle with a general fall in the stream of 2.5 feet in 1,000.

At or near Ferndale bridge, at the southern limit of the city, the slope of the stream changes, and for 30,000 feet, to the northern limit of the city, the natural slope of the channel was originally 1.1 feet in 1,000. Wherever the channel is not obstructed, this rate of descent is still maintained by the stream, but owing to obstacles which have been placed in the way of the flow of the water, depressions in the bottom have been scoured out, bars have been formed below them, and consequently the slope of the surface of the water has been made very irregular, as will be seen by examination of the profile of Stony Creek, "Plate 23," which is prepared from the surveys made under my direction in April and May, 1891.

Judging from the extent and character of the water-shed and the data furnished by the records of the great floods and the areas and slopes of the river channels, it is probable that in the greatest freshet that may be expected in this stream the volume of water for which passage ought to be provided in the channel of Stony Creek, from the southern limit of the city to the junction with the Little Conemaugh, is 30,000 cubic feet per second. With both streams in flood, the volume which will be carried in the Conemaugh River below the confluence will be about 45,000 cubic feet per second.

The channel of the rivers must be so proportioned that the water of the highest flood will not overflow its banks and inundate the city.

The greatest flood in Stony Creek of which there is any record was that of June 7, 1887, in which there was, as nearly as can be computed, 30,000 cubic feet per second flowing in Stony Creek.

At that time there was very little water flowing in the Little Conemaugh River.

The next highest flood of which records are accessible was that of February 17, 1891, in which the surface velocity at Franklin Street was measured by the engineers of the Cambria

Iron Company. From the data furnished by them regarding this measurement, compared with my own computations on several sections of the river where records of the flood had been preserved, the discharge of the stream was about 22,000 cubic feet per second.

In the Conemaugh River, below the confluence, the discharge of the June flood of 1887 was about the same as that of the February flood of 1891. Both Stony Creek and the Little Conemaugh River were in flood at the latter date, and the quantity of water flowing in the Conemaugh was, according to a velocity measurement made at the Cambria Iron Company's coal bridge by the engineers of the Cambria Iron Company, as compared and corrected by my accurate cross sections of the river and the observed heights of the flood water at various points—about 33,000 cubic feet per second.

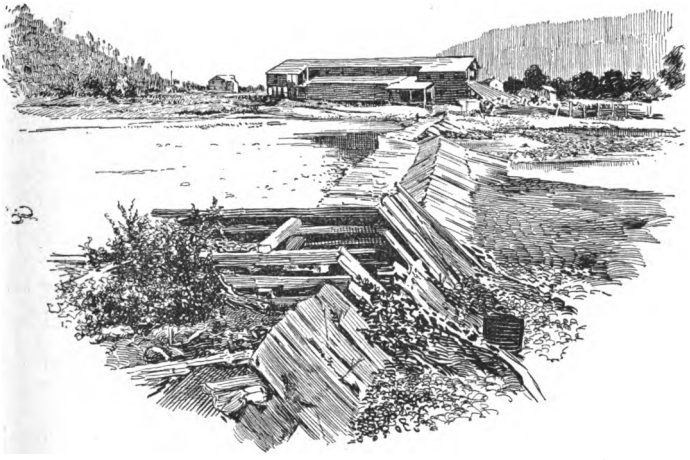
An examination of the profile "Plate 23," on which are shown the river bed and low water surface from my surveys of April 1891, and the high water surface of both of the floods mentioned above, from data furnished by the engineers of the Cambria Iron Company, from observations made at the time of the floods, shows very clearly the points along the course of the rivers at which obstructions to the natural flow of the stream have been created.

Such obstructions are of two kinds, and one is consequent upon the other. A contraction of the water-way may occur either from a narrowing or from a shallowing of the channel: that is, either from the banks being drawn together or from the bottom being raised. A narrowing of the water-way causes an elevation of the water surface. The result of such contraction of water-way and elevation of the water is a scouring out of the bottom of the stream near the obstruction and the creation of a bar below it, at a point where the channel is widened again. Wherever such a bar occurs, the channel must be wider than where the stream is in its normal condition.

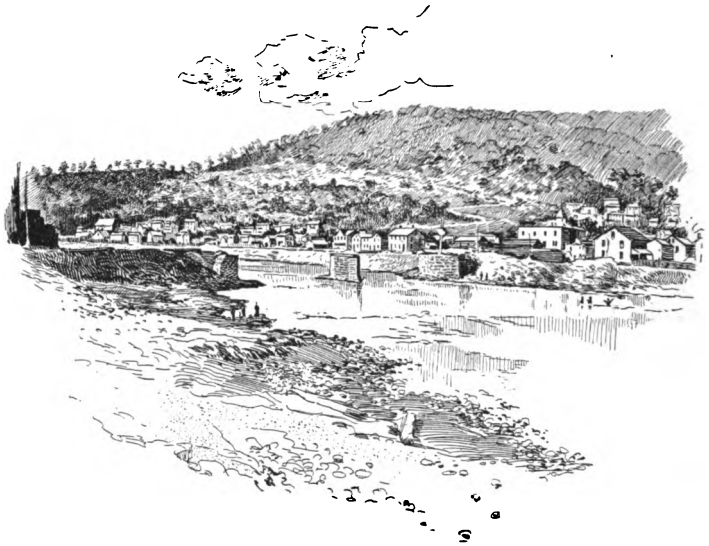
To carry the flood water of Stony Creek on a regular gradient from the Ferndale Bridge to the mouth of the Little

Conemaugh River, and the waters of the Conemaugh River from that point to the northern limit of the city, without overflowing the river bank and inundating Johnstown, the channel of Stony Creek must be 225 feet wide and 16 feet deep at high water, and have an area of water-way of 3,400 square feet, and the channel of the Conemaugh River must have 5,000 square feet area of water-way, with a depth of 18 feet below the maximum flood line. In each case the surface of the water must have a slope of 1.156 feet (nearly 14 inches) in 1,000 feet.

The profile "Plate 23," shows that at Ferndale Bridge (sta. 331.40), which is 186 feet wide between the abutments, there has been a slight obstruction, the bottom being gouged out and a bar formed below it. In floods the water overflows bottom lands on the east side a little below this point. At sta. 295 the stream makes an abrupt bend to the right, against a rocky bank, with a radius of about 500 feet, the result of which is shown by a gouge in the bottom. At Moxham Bridge (sta. 286) which has a width at low water of 250 feet, and at high water of 324 feet, the river has nearly resumed its normal condition, being 2 feet deep at low water and about 17.5 feet deep at high water, the excessive area showing a retardation of the current due to the sharp curve in the stream just below, the river going around



25. OLD DAM ON STONY CREEK.



26. STONY CREEK AT POPLAR STREET.

an entire semicircle on a radius of about 500 feet, the result being shown in a gouge in the bottom of the river about the centre of the curve.

At sta. 259 there is an old dam, formerly used by the Johnstown Lumber Company. This dam is 360 feet long and is now in a dilapidated condition, as may be seen by "Plate 25." It offers no serious obstruction to the channel of the river, but still tends to raise the flood water back of it and ought to be removed.

The B. & O. Bridge at sta. 248 has two piers standing in the channel, but has a clear water-way of 295.8 feet between abutments. A very slight depression of the bottom is noticeable, due to the piers in the channel, but no serious obstruction is created.

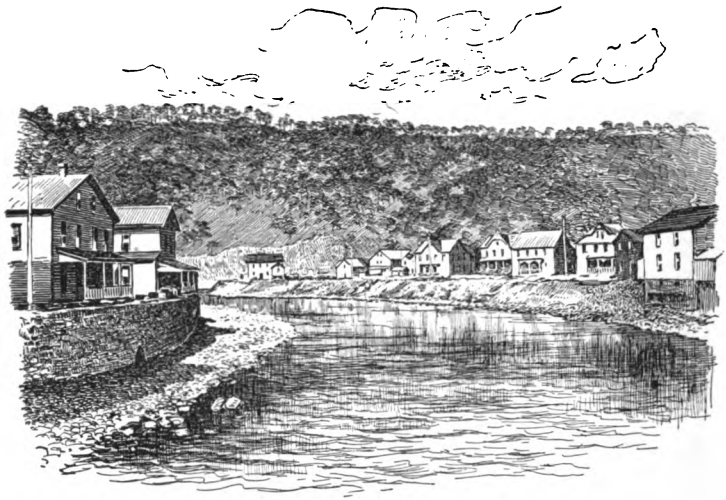
Below sta. 242, where the Valley Pike strikes the river bank, an encroachment has been made on the west shore of the river by filling and building walls and houses beyond the original bank lines. At present this does not materially affect the water-way, as the opposite bank along the cemetery is low, and is overflowed at any rate in high water. When the east bank shall be raised to prevent overflow these encroachments on the west bank will

be objectionable and dangerous, and will prevent the lowering of the flood level to the desired line.

At sta. 214 the abutments and pier of the Poplar Street Bridge restrict the water-way to a width of 174 feet. The result is shown in this case, not in the gouging of the bottom, which is of a very compact gravel, but in the raising of the water surface, which was, in both freshets noted above, 2 feet above the normal level of the stream at that point as indicated by the slopes of the surface above and below. The contraction of the river at this point is shown on "Plate 26," a view taken from the west bank looking down stream. In the flood of June 1887, the water rose over the tops of the piers. In both floods it overflowed the east bank and ran down into the city.

At sta. 207, where Somerset Street strikes the river, a contraction occurs by encroachments on the west bank, and cinder dumps along the B. & O. R. R. on the east bank. The narrowest point is at sta. 202.50, near South Street, where, at 15 feet above the bottom, the river banks are only 150 feet apart, and the result is shown in the gouging out of the bottom, and an elevation of the water surface of over 3 feet in floods. The contraction of the river at this point is shown on "Plate 27," a view taken from the river bed at the foot of South Street, looking south.

27. STONY CREEK AT SOUTH STREET.



28. STONY CREEK BELOW FRANKLIN STREET.

At Haynes Street (sta. 189) the river has nearly regained its normal condition. Between that point and the Franklin Street Bridge the banks of the stream have been, and are now being contracted by the erection of walls, narrowing the channel to about 170 feet, the effect of which is shown in an elevation of the water surface above the normal slope. This contraction extends for about 700 feet down the stream from the Franklin Street Bridge, and its effect is seen on the profile in the deep gouge of the bottom at sta. 168, on the sharp curve north of Kernville, where the creek abuts against the high bank to the west, and is deflected to the north at nearly a right angle.

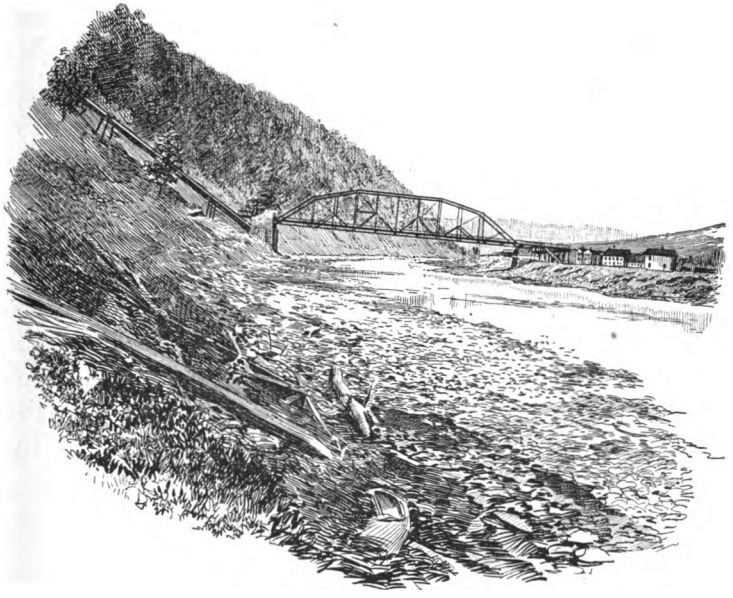
The contraction of the channel on this reversed curve from sta. 163 (Potts Street) to sta. 189 (Haynes Street), a distance of 2,600 feet, is one of the most effective agents in causing the flooding of Johnstown and Kernville, the water level being backed up to such an extent as to cause the banks to be overflowed on each side above the bend. The encroachments on the water-way by walls and cinder dumps on this curve are shown on "Plate 28," which is a view from the Franklin Street Bridge looking down stream.

With the channel under the bridge cleared of the old obstructions which still remain between the new abutments of

the bridge, and the channel above and below correspondingly widened, the danger of overflow between South Street and Walnut Street would be greatly reduced.

Below Walnut Street (sta. 160), the effect of the inflow of the Little Conemaugh, half a mile further down the stream, is felt in the channel of Stony Creek in the present condition of the channel. This is shown very clearly on the profile of the high water of both June 1887, and February 1891.

At sta. 151 is the Plane Bridge of the Cambria Iron Company. The clear span of this bridge is 226 feet, and the area of water-way to the assumed high water level is about 3,200 square feet. The water level at this point in an extreme flood such as that of June 1887, with the proposed improvements of the channel, would be about 1 foot lower than the flood level of February 17, 1891, which is indicated on "Plate 29," by a line drawn across the east abutment of the bridge about 2 feet above the level of the top of the river bank at that point.



29. STONY CREEK AT THE PLANE BRIDGE.

30. STONY CREEK, LOOKING NORTH FROM PLANE BRIDGE.

The bottom of the river at this point is higher than it should be, and is evidently filled up by deposits caused by the great freshet of 1889. Its present condition is shown on "Plate 30," a view taken from the bridge looking down stream.

At the mouth of the Little Conemaugh River (sta: 137), the channel should be of the proper width and depth to admit of the increased volume of water from the Little Conemaugh, and the area of water-way at this point should be 5,000 square feet below the elevation 1,163.27, and the east bank of the Little Conemaugh should be cut off on a regular curve so as to admit of the water flowing into the Conemaugh River more in the direction of the course of the river.

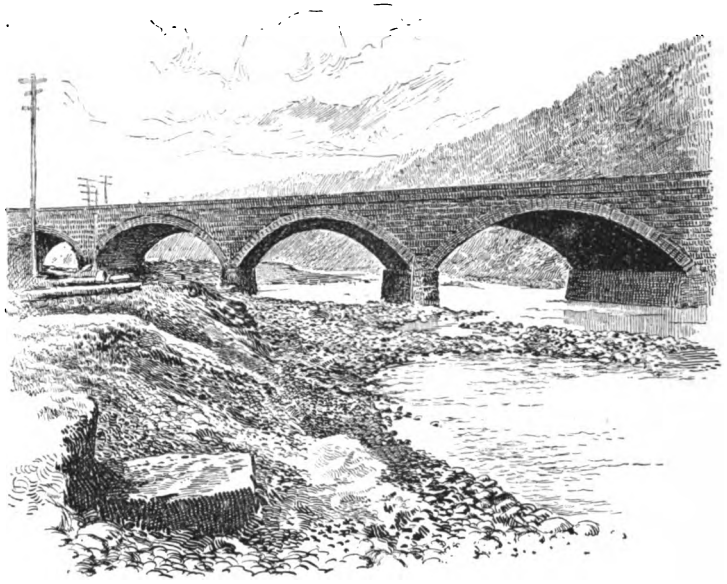
The Conemaugh River.—At sta. 128, 700 feet below the mouth of the Little Conemaugh River, is the stone bridge of the Pennsylvania Railroad Company, a general view of which is given in "Plate 31." This bridge has six openings of 44.25 feet, and one opening of 33 feet width. Of these seven openings, one is

occupied by a railroad track, one by Iron Street, one is largely obstructed by rough material dumped in, and four are available for the passage of water at low and medium stages.

The water at this point in the flood of February 17, 1891, rose 5.6 feet above the spring line of the arches and was 6 feet deep over Iron Street and the Cambria Company's railroad track. In the flood of June 7, 1887, before the stone bridge was built, the water rose here to the same height as it did in the flood of 1891. The area of water way at the bridge below the highest recorded flood level is the same now as it was before the stone bridge was built.

The obstruction to the flow of the river at this point is indicated on the profile by a deep gouge in the bottom, the character and extent of which is shown on "Plate 32," which is a topographical map of the bed of the river at that point, with contour lines at every foot of elevation. This map shows that at the centre of each of the three openings through which the main stream flows, on the up stream side of the bridge, the bottom is gouged out from 4 to 5 feet below the level of the bottom above and below the bridge, and that across the channel about 100 feet below the bridge a bar is formed from 1 to 2 feet higher than the bottom 200 feet above the bridge. The profile further shows that the surface of the slope of the water below the bridge was very much steeper than it was above the bridge. This indicates that there is not sufficient water-way in the channel as now existing at this point.

31. THE STONE BRIDGE, LOOKING DOWN STREAM.



83. OBSTRUCTED ARCHWAYS, AT EAST END OF STONE BRIDGE.

The proposed channel necessary to carry off the flood water of the Conemaugh below the bridge must have 5,000 square feet area. The obstruction to the channel by piers situated as these are, is such that a water-way of 6,250 square feet will be necessary to pass the same amount of water.

To obtain this water-way below the level of the assumed high water at this point, all the openings between the extreme abutments of the bridge must be cleared out to the depth of 17 feet 8 inches below the top of the bridge piers at the spring line of the arches. That is about the same depth as now exists on the south side of the bridge in the two most westerly openings.

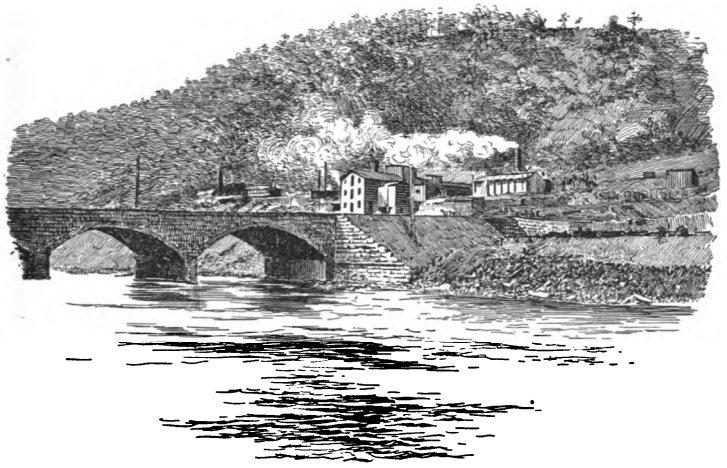
To convey the same amount of water as flowed down the stream at this point in the flood of June 7, 1887, or that of February 17, 1891, and have the surface of the water at the desired elevation for floods, it would be sufficient to clear out the six wider openings to a depth of 15 feet 4 inches below the spring line, or about the same as now exists on the north side of the bridge, in the two most westerly openings.

If, with only six openings thus cleared out, such a freshet should occur as is possible, the water would be backed up in Stony Creek about two and a half feet higher than the floods of June 1887, or February 1889, which would overflow the present banks above the Plane Bridge, and would probably be felt as far up stream as Poplar Street.

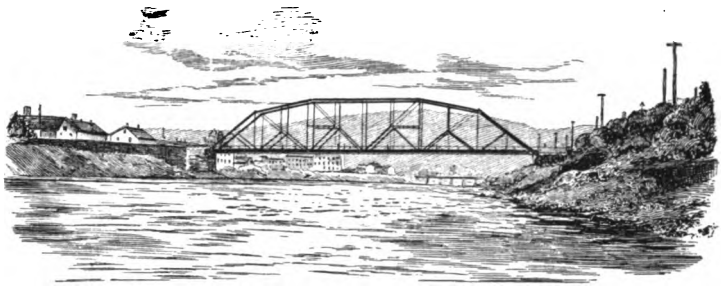
The present condition of the bottom of the river in the fourth, fifth and sixth openings is clearly shown on "Plate 33."

"Plate 34" is a view of the two most westerly openings, taken from below the bridge looking southwest. It appears from this view, in connection with the plan ("Plate 32"), that there exists between the west abutment of the bridge and the coal road of the Cambria Iron Company, on the west bank, sufficient space for another span to be added to the bridge without interfering with any railroads or buildings.

At Station 116 the coal bridge of the Cambria Iron Company spans the stream, with an opening of 277 feet between the abutments. To secure sufficient waterway at this point, the bottom of the river will have to be deepened, and the mass of material dumped in on the east bank, as indicated on "Plate 35," will have to be removed.



34. WEST END OF STONE BRIDGE, FROM BELOW.



35. CONEMAUGH RIVER AT COAL BRIDGE.

The channel below the bridge is reduced in area by material which has been deposited on both sides of the river, and the result is shown by the scouring out of the bottom for a distance of about 3,000 feet. The nature of the banks is shown on "Plate 36," and the contraction near the mouth of Hingston's Run is shown on "Plate 37." At this point the width of the channel between the top of the banks is only 188 feet.

The deposit of cinder from the Cambria Iron Works has been continued down the river to below the southern limit of Johnstown. "Plates 38 and 39" are views of the channel looking, respectively, up stream and down stream from the mouth of Hingston's Run.

On the south bank there was originally a wide bottom land overflowed by freshets. This has been largely filled in with cinder, contracting the water-way. At this time, the banks, though raised by the cinder which has been dumped on them, are below the high water level, and down as far as Ten-acre bridge, the freshet of February 1891 overflowed a considerable area. The high water level of that freshet was generally two feet higher than that of June 1887, showing that in the three and a-half years between the two floods, there had been a material reduction of the water-way on this reach of the river.

CROSS SECTION OF THE RIVER.

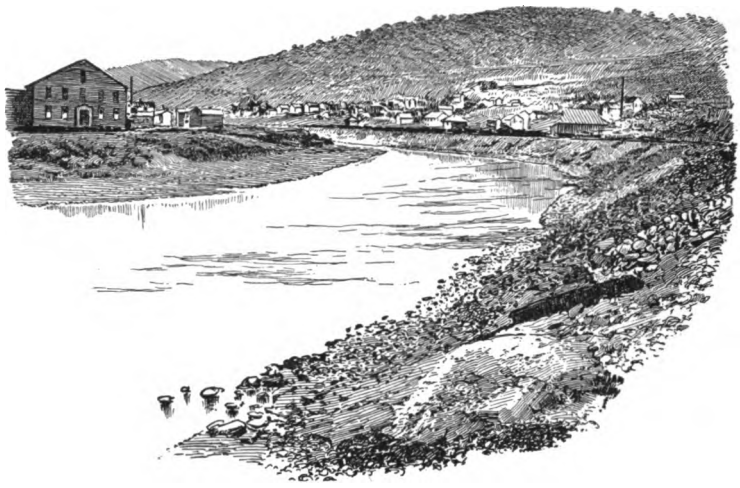
Cross sections of the rivers at 47 different points are submitted herewith, and also a typical cross section of each of the rivers.

To enable a comparison to be readily made between the condition of the stream as it is and as it ought to be, a tabular statement on " Plate 1 " gives the relative elevation of the existing banks and the high water of freshets. The actual areas of the water-way between the existing top bank lines at several points on the river, up to the highest level to which the water would rise in the proposed improved channel, are given in this table and also the areas as they should be.

By your direction, no attempt has been made to fit the exact lines to be followed in adjusting the banks of the rivers, that being a matter requiring time and a careful consideration of local circumstances.

The object to be kept in view in so adjusting the banks, is to restore the channel to its natural location and slope as nearly as possible, with the least expenditure and encroachment on

38. LOOKING UP-STREAM TOWARDS TEMPORARY BRIDGE.



37. CONEMAUGH RIVER AT MOUTH OF HINGSTON'S RUN.

riparian rights, not the least important of which is the right to have the channel further down stream maintained wide enough to give free discharge to the water and not back it up to an injurious extent.

RECURRENCE OF FRESHETS.

There is not any probability that there will be an increase in the frequency of great freshets, or in their volume, in consequence of the fragmentary clearing of the timber lands on the remote mountainous districts of the water-sheds of the streams in this valley.

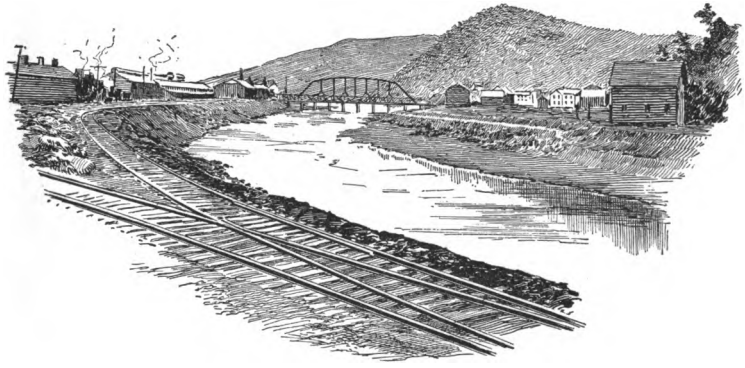
The clearing of the timber from a limited area of steep hill-side may have the effect of permitting the water of moderate rains to reach the streams more rapidly, and may thus cause more frequent and rapid fluctuations of flow at moderate stages of the stream. In heavy rainfalls, however, the proportion of the water arrested by the foliage is so slight that, practically, it makes no difference in the volume of water at the height of the flood, whether the land is heavily timbered, or is covered with brush and second growth, or is cultivated. The proportion of cleared land to forest is so small, moreover, in these water-sheds, that all

the clearing and occupation likely to occur during the lifetime of any one now living is not likely to cause any perceptible variation in the discharge of the rivers. The water-way provided for in the plans submitted is sufficient for any flood likely to occur from natural causes.

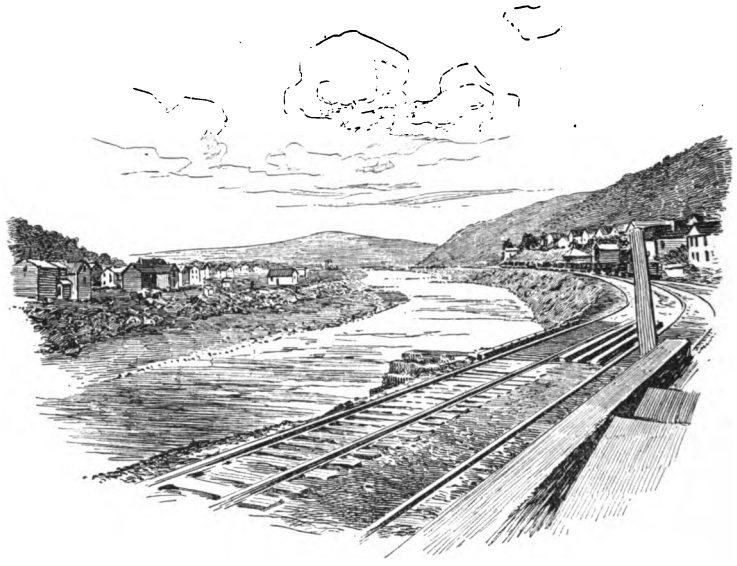
GENERAL SUMMARY.

As a summary of the conclusions reached from the examinations I have made, as stated in the foregoing report, I have to say: The only possible source of danger to that portion of Johnstown south of the stone bridge, from any structures existing on the streams tributary to Stony Creek and the Little Conemaugh River, is the washing down of logs stored in the Lumber Company's dam at the mouth of Shade Creek by the breaking away of the Splash dam on Clear Shade Creek. In view of the possibility of such an event occurring, it is desirable that provision should be made in the Splash dam for the overflow of the water of freshets through a spillway, which can be readily constructed in that part of the dam which is now made of sheet piling only. The rest of the dam should be raised three feet and the cribs filled with stone.

To that portion of Johnstown north of the stone bridge, which was formerly known as Morellville, there is a possibility of disaster from the failure of the saw-mill dam and the St. Clair dam on Mill Run. Neither of the dams on this stream can be looked upon as safe.



38. UP STREAM FROM MOUTH OF HINGSTON'S RUN.



39. DOWN STREAM FROM MOUTH OF HINGSTON'S RUN.

As regards the rivers within the city limits, the inundation of that part of Johnstown south of the Little Conemaugh in floods such as (from the experience of 1887, 1889 and 1891) may be expected every second year, is caused almost entirely by the contraction of the channel of Stony Creek, between the south end of Market Street and the point where the Valley Pike strikes the river, about a thousand feet below the Baltimore and Ohio Railroad bridge. The contraction of the river between these points produces the raising of the water surface south of Franklin Street to such height as to overflow both the east and west banks and flood Meadowvale, Kernville and Johnstown.

The obstructions which have been placed in the way of a full discharge of the water of the Conemaugh River below the mouth of the Little Conemaugh do not appear to have ever raised the water above the mouth of the Little Conemaugh to such a height as to overflow the city between Stony Creek and the Little Conemaugh to any great extent. The main volume of water has come into the town over the river banks east and south of Franklin Street.

The obstructions to the flow of the Conemaugh River are caused first, by the piers of the Pennsylvania Railroad Bridge; secondly, by the contraction of the water-way below the bridge by deposit of material from the iron works.

The raising of the water below the mouth of the Little Conemaugh, in the greatest floods which are recorded, has been such as to injure the Cambria Iron Company by flooding their works, but has not been such as to injuriously affect the city of Johnstown south of Walnut Street. The water of the great freshets below the bridge has always overflowed the lands west of the stream, and the raising of the surface of the ground there to admit of the construction of buildings has not been great enough to prevent such flooding, and the only remedy for this state of affairs is to still further raise the whole surface of the ground which has been occupied, taking care to leave in addition to that a sufficient channel for the stream; that is a channel having five thousand square feet of water-way.

As regards the stone bridge of the Pennsylvania Railroad, experience has shown that the five openings of the stone bridge which are in the water-way of the river, are insufficient to pass the water of the greatest floods recorded, but that the water rose 7 feet over the east bank and flowed through the two openings which are used for travel. It is desirable to lower this flood water at least 2.5 feet, so as to make the surface slope of the stream uniform through the city, and this can be accomplished by the clearing out of six of the openings between the piers.

If Iron Street is to be permitted to remain in its present position it would be possible to construct another opening to the west of the present west abutment of the bridge, and this would afford sufficient water-way below the desired flood level, for any freshet which has so far occurred, but would not afford room enough for the passage of such a freshet as may occur, judging from the experience of other similar streams. Such a freshet would probably raise the water nearly 5 feet higher at the bridge, and back the water of Stony Creek up to Poplar Street, making it at Franklin Street Bridge about the same height as the flood of June 7, 1887.

This is the worst that could be expected, and no damage to Johnstown could result from it, provided that at all points along the line of the stream from one end of the city to the other, where the natural surface of the bank is below the assumed flood level as indicated on the profiles and plans, the banks of the river be protected by dikes carried up to a proper height above the assumed maximum level, and such height should range from 5 feet at the stone bridge to 2 feet at the B. & O. R. R. bridge at sta. 248.

With the channel widened, and where necessary deepened in the manner indicated on the plans and profiles and hereinbefore recommended, I believe that the great and ever imminent danger to Johnstown from being inundated by the water of Stony Creek flowing into the city over its banks, between the Baltimore & Ohio railroad bridge and the Franklin Street bridge, may be permanently averted. Without the rectification of the channel between these points, such danger will always exist.

I desire to express my obligations to the members of the committee, and to many other citizens of Johnstown and vicinity, who have furnished all the information at their disposal.

In the preparation of maps and plans I have been greatly aided by the data and maps furnished by Captain Downey, City Engineer.

The surveys, including the verification of the City Engineer's maps, the making of forty-seven accurate cross-sections of the channel of the rivers, the location and measurement of the principal dams and reservoirs, the collection of information, and the preparation of the maps and plans, have been conducted by Charles W. Hunt, C. E., in a very prompt, thorough and satisfactory manner.

All of which is respectfully submitted.

J. J. R. Croes.